Small Business Innovation Research/Small Business Tech Transfer

Silicon-Carbide (SIC) Multichip Power Modules (MCPMS) For Power Building Block Applications, Phase I

Completed Technology Project (2005 - 2005)

Project Introduction

This Small Business Innovation Research Phase I project seeks to prove the feasibility of developing high power density modular power electronic building blocks based upon high temperature silicon carbide (SiC) multichip power module (MCPM) technologies. The modular approach will allow for auto-configurable stackable modules to be built up in series and/or parallel configurations (through a "plug and play" fashion) in order to increase overall system power handling capabilities. The MCPM building blocks will utilize a decentralized control and communications structure, with a communications network established between the core silicon-on-insulator (SOI) controllers of the MCPMs, but with no single controller in command of the system. The decentralized control scheme will allow for the construction of highly flexible power systems which could perform a wide variety of power electronics applications, including power conversion, motor drive, and power distribution functions. In addition, the development of the MCPMs will be based upon high-temperature SiC power electronics technologies, thus driving the building block designs towards very miniaturized, high power density, high efficiency systems. Due to the high switching frequency capabilities of the SiC power switches, filter and magnetics components will also be reduced in size, thus further miniaturizing the MCPM building blocks. The reduction in size, weight, and volume will create significant savings in space launch costs, while the modular building block designs will increase flexibility, reduce engineering costs and time, improve reliability and fault tolerance, and allow for the implementation of auto-reconfiguration in the case of phase-leg or module failures.

Anticipated Benefits

Modular flexibility makes the proposed technology attractive for a wide variety of power electronics applications, but more importantly, the potential of a single basic building block to perform the majority of power electronics functions would revolutionize the power electronics industry. Very high volume manufacturing would significantly reduce system-wide costs, while auto-configurable "plug and play" systems would reduce power engineering and design costs. Baldor Motors, one of the world's leading manufacturers of electric motors and drives, has shown great interest in the potential of this technology for the commercial market-place, and has provided a support letter. NASA applications that will benefit from high-temperature SiC modularized power electronic blocks include satellites, spacecraft, aerospace vehicles, rovers, and landers to name a few. The proposed modules will offer flexibility, reparability, and modularity to power distribution systems including solar arrays, energy storage devices, and nuclear power cores. Any NASA power system that would see an improvement by increasing power density, reducing weight and size, and increasing fault tolerability could potentially benefit from the proposed technologies. The power system engineers will have the flexibility to adapt these modules to practically any power electronic

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

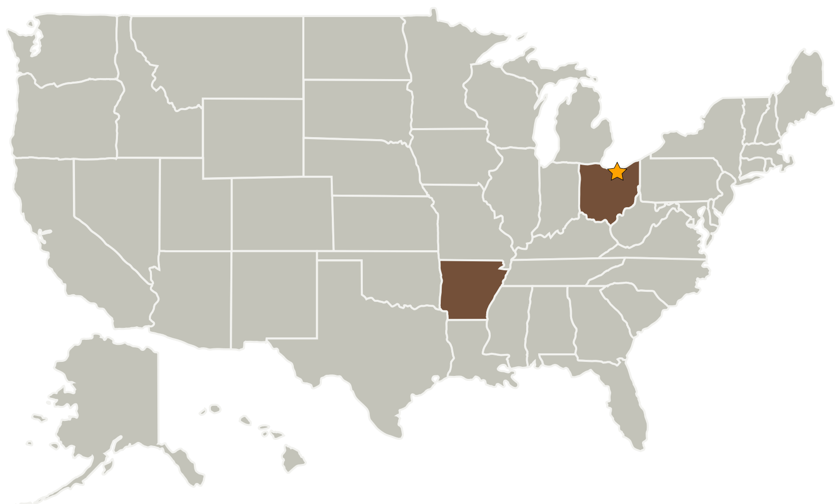
Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer application, thus significantly reducing the engineering and design costs while simultaneously improving reliability.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Arkansas Power Electronics International, Inc.	Supporting Organization	Industry	Fayetteville, Arkansas

Primary U.S. Work Locations	
Arkansas	Ohio

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Ramon C Lebron-velilla

Principal Investigator:

Alexander Lostetter

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  └ TX11.1 Software Development, Engineering, and Integrity
    └ TX11.1.4 Operational Assurance